Upper Salmon River Spring Chinook Salmon

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Idaho Department of Fish and Game

Upper Salmon River spring chinook salmon are a very unique population of salmon. These fish represent the furthest migrating chinook salmon in the lower 48 states, with their spawning/nursery grounds located more than 900 river miles from the ocean. Also, spawning and nursery habitat for these fish is located at over 6,000 feet above mean sea level. The LSRCP program for spring chinook salmon in the upper Salmon River basin consists of the Sawtooth Fish Hatchery and its East Fork Salmon River satellite facility (Fig. 1). The hatchery, located near the town of Stanley, Idaho, was completed and the facilities became operational in 1985. The East Fork Salmon River satellite facility serves only adult trapping and spawning functions for chinook salmon, all rearing is performed at Sawtooth Fish Hatchery. The hatchery program provides in-kind mitigation for spring chinook salmon losses associated with the construction of the four lower Snake River hydroelectric projects.

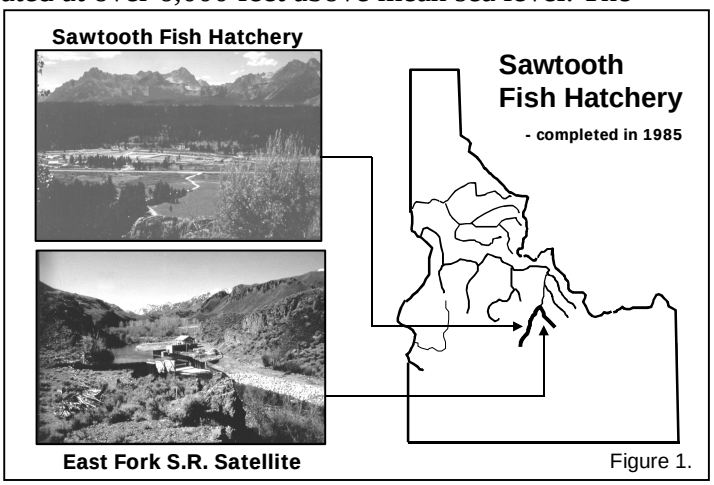

Figure 1.

Sawtooth Fish Hatchery consists of typical incubation and rearing facilities. Incubation and early rearing is performed indoors utilizing pumped well water. Final rearing, to fish release, is done in outside raceways utilizing raw river water. The outside raceways measure 12 feet wide by 200 feet long.

Production models used to identify facility needs included an assumed smolt-to-adult (SAR) survival rate of 0.87%, which was applied to the annual adult return goal of 19,445 adults to determine needed juvenile rearing capacity. The adult return goal is specified as fish returning to the LSRCP project area, above Lower Granite Dam. Annual salmon smolt production capacity at Sawtooth Fish Hatchery is 2.98 million smolts at 20 fish per pound or 2.3 million smolts at 15 fish per pound. Initial facilities-operation planning identified 1.3 million smolts to be released at Sawtooth Fish Hatchery (11,310 adult return at 0.87% SAR), and 700,000 smolts released into the East Fork Salmon River (6,090 adult return). The remaining 300,000 smolts, for a total annual release of 2.3 million, were to be released in Valley Creek in the upper Salmon River basin and the Yankee Fork Salmon River.

Natural production of chinook salmon in the upper Salmon River basin has declined substantially over the past three decades. From 1958 to 1962 an average of 481 redds was counted annually in spawner index areas upstream of Valley Creek (Fig. 2) (Valley Creek enters the main Salmon River at the town of Stanley). Tributaries to the Salmon River in the upper basin provide additional spawning and rearing habitat; annual spawner escapement to these areas is not included in the index area redd counts. During the period 1979 to 1983 an average of only 93 redds was counted annually in spawner index areas, and by the period 1993 to 1997 an average of only 33 redds was counted each year. In addition to supporting natural spawning, adult escapements through the mid- to late 1970s supported substantial harvest opportunities. From 1970 through 1978 sport harvest in the Salmon River ranged from 400 to 2,260 chinook salmon annually. Not all of the fish harvested were destined for the upper Salmon River basin, as numerous stream miles down stream of the town of Stanley were open to fishing. No chinook salmon sport fisheries have occurred on the Salmon River or its tributaries (excluding the Little Salmon and South Fork Salmon rivers) since 1978.

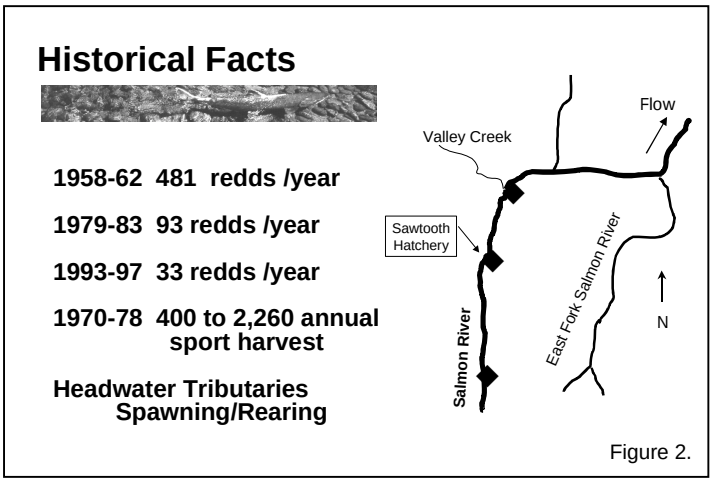

Figure 2.

Brood stock development associated with Sawtooth Hatchery was initiated in 1980 with the release of 168,000 smolts near the current hatchery site, and in 1981 230,550 smolts were released (Fig. 3). Both of these releases were from upper Salmon River stock. These fish were reared at McCall Fish Hatchery (Sawtooth Fish Hatchery was not completed until 1985) before being released into the upper Salmon River. During the late 1970s Rapid River stock juveniles were released into the East Fork Salmon River and upper Salmon River in response to severe declines in adult escapement (Fig. 4). It is not known what adult escapement to the upper Salmon River or East Fork Salmon River resulted from these releases. Since completion of Sawtooth Fish Hatchery and trapping facilities at the hatchery and on the East Fork Salmon River, only local

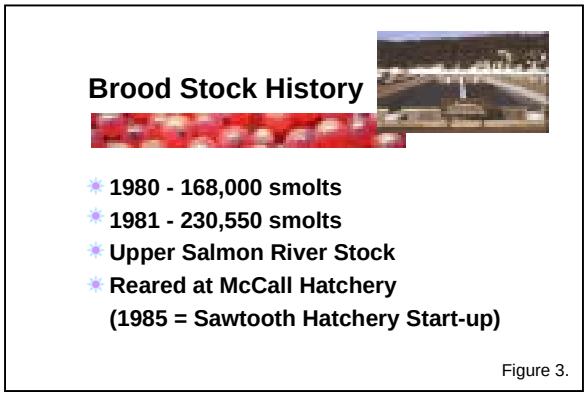

Figure 3.

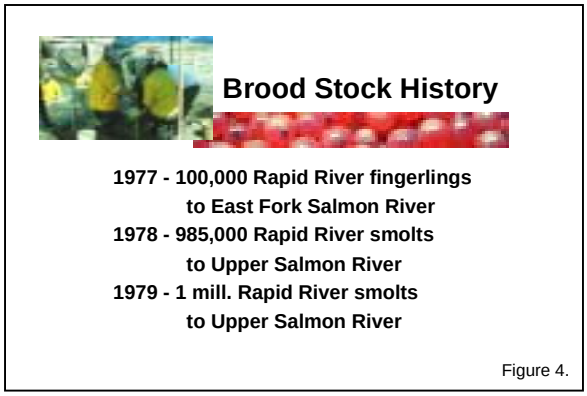

Figure 4.

brood stock has been used for the respective programs.

Green egg to smolt survival rates for salmon reared at Sawtooth Fish Hatchery are shown in Figures 5 and 6. The 70% survival target shown is not a hatchery management goal, but rather is the value used in the original production model to identify facility needs. It is included here for reference. Egg to smolt survival for brood years 1981 through 1984 represents rearing at other facilities prior to completion of Sawtooth Fish Hatchery. Beginning with brood year 1985 rearing of upper Salmon River stock (Fig. 5) and East Fork Salmon River stock (Fig. 6) at the Sawtooth facility, egg to smolt survival has been quite high and stable. The low egg to smolt survival for brood year 1992 was the result of an out break of fuzzy tail disease. Attempts to duplicate this disease outbreak were unsuccessful. The cause of the outbreak remains unknown and the disease has not been observed in subsequent brood years. Hatchery management practices and research activities will continue to seek survival improvements. However, substantial increases are unlikely since survival is continuously high, especially as measured from the green egg stage.

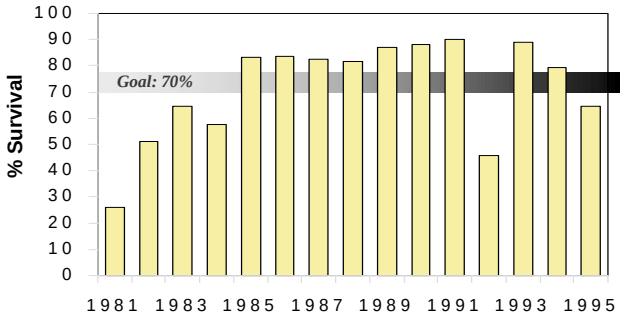

Figure 5.

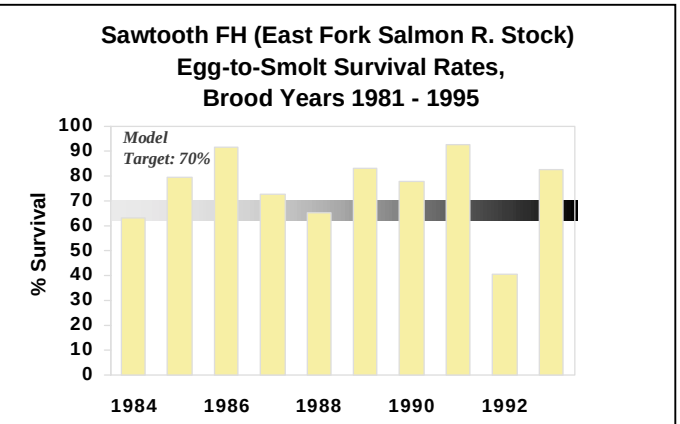

Figure 6.

Smolt releases into the upper Salmon River reached or exceeded the target release number for only three brood years since hatchery start-up (Fig. 7). Releases shown in Figure 7 for brood years prior to 1985 are upper Salmon River stock that were reared at McCall Fish Hatchery. Initial brood stock management plans, for both upper Salmon River stock and East Fork Salmon River stock, specified using up to one-third of the returning natural origin fish for hatchery brood stock. Since 1991, adult returns have been insufficient to meet hatchery egg-take goals. In

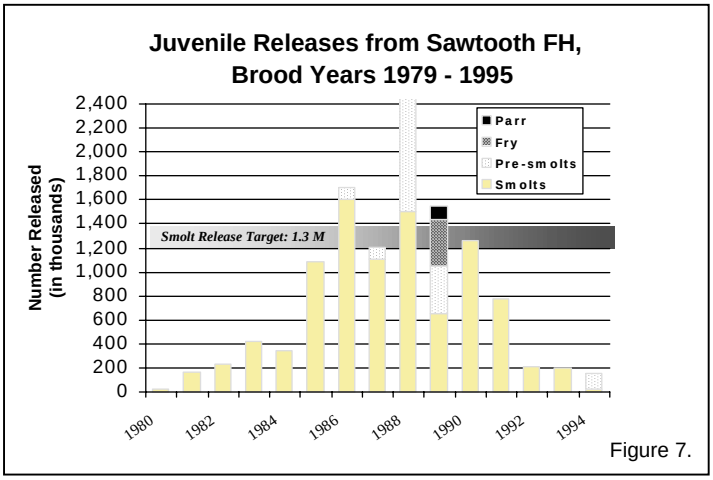

Figure 7.

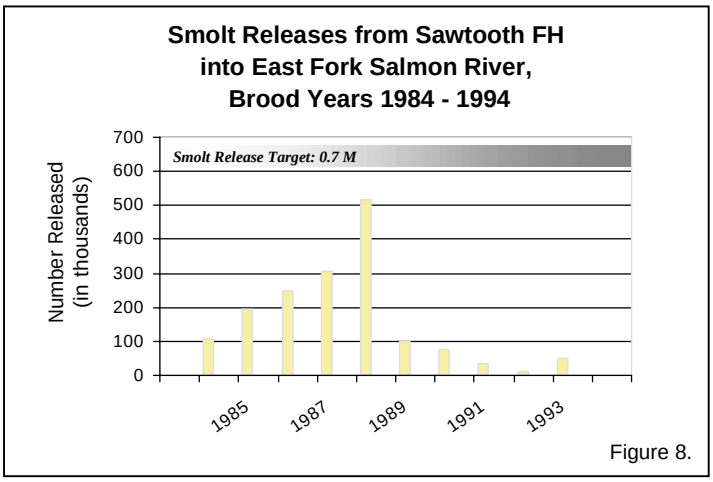

Figure 8.

1994 a total of only four females were captured at the hatchery rack; two were hatchery-origin adults that were spawned and produced 4,000 smolts. Smolt releases of East Fork Salmon River stock have never achieved the target release number (Fig. 8). Since the inception of the hatchery program on the East Fork Salmon River, adult returns have been too low to meet the egg-take goal. No fish were trapped for hatchery brood stock from 1994 to the present. A captive rearing program was initiated for the upper East Fork Salmon River natural population in response to the critically depressed status of the population. Naturally produced fish from brood years 1994 and 1996, collected as juveniles, are currently being reared for this program.

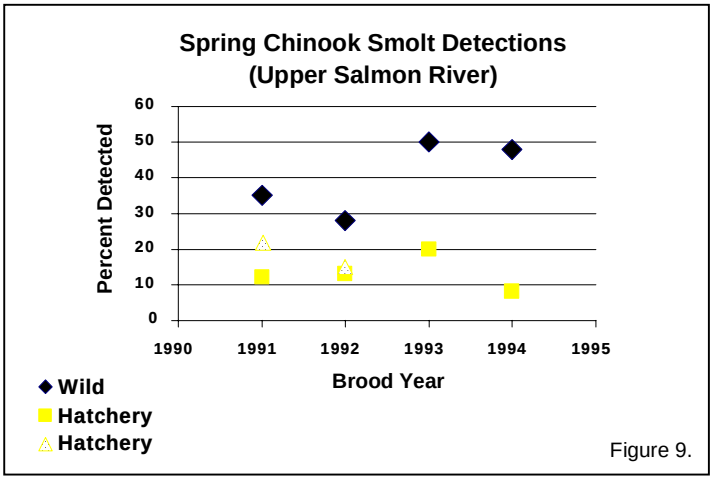

Figure 9.

A relative measure of "performance" of juveniles released is detections of PIT-tagged fish at downstream dams. The data points plotted in Figure 9 represent the cumulative proportion of PIT-tagged fish that were detected. These proportions detected provide an estimate of the minimum proportion of fish released that reached the first dam (Lower Granite).

In Figure 9 cumulative detection rates for one or two groups of hatchery fish (squares and triangles) are shown for four brood years. Also shown are cumulative detections for wild summer chinook salmon juveniles (diamonds) tagged in the upper Salmon River. The detections of wild fish are included for general comparison only, since the detection rates reported have not been adjusted for arrival timing, fish guidance efficiency at the time of arrival, spill at the dams, etc. Therefore, absolute comparisons can not be made between the hatchery and wild fish within any year.

The detection rates shown in Figure 9 do provide year to year relative comparison of smolt quality and performance. It is important to note that to date, no good uniform measure of smolt quality has been developed. However, if we are concerned with the quality of smolts the first indication of a "bad" group of fish would be reduced egg to smolt survival. It was shown in Figures 5 and 6 that green egg to smolt survival has consistently been quite high,

indicating good smolt quality.

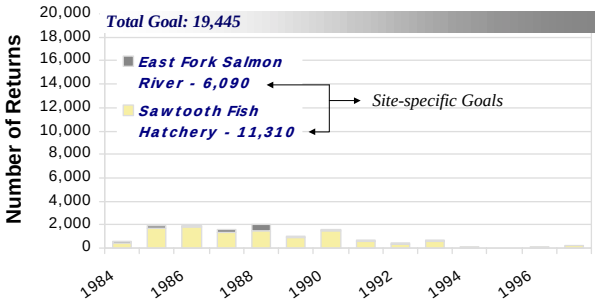

Figure 10.

Adult spring chinook salmon returns to the upper Salmon River weir and East Fork Salmon River weir combined, from hatchery releases, are show in Figure 10. The adult return goal has never been met; in the best years total returns to the two weirs combined were about 20% of the goal. It must be noted that the returns documented here are to the hatchery weirs, and that the compensation goal is to the project area - i.e. above Lower Granite Dam. However, no fisheries have occurred on these fish between Lower Granite Dam and the weirs. In some of the early years natural fish may be included in the estimated return, since they could not be distinguished from fish originating from the hatchery releases. Fallout below the weir, of fish returning from hatchery releases, is not included in the returns shown.

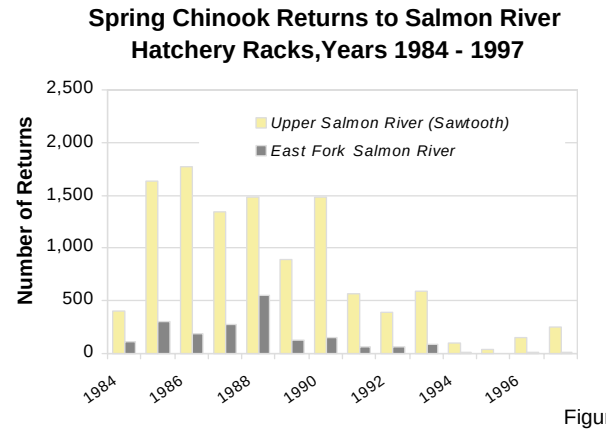

Figure 11.

The same returns shown in Figure 10 are again shown in Figure 11, except the y-axis has been expanded. Returns in the earliest years could not have been expected to achieve the return goal. For example, releases that would have contributed to the age 5 and age 4 returns in 1985, respectively, were 168,000 brood year 1980 smolts released in 1982 and 230,550 brood year 1981 smolts released in 1983 (Fig. 7). Releases for brood years 1985 – 1987 were near or exceeded the target number for release into the upper Salmon River (Fig. 7). However, it is clear in Figure 11 that the numbers of adults returning in 1989 – 1992 from these releases were far less than the return goal of more than 11,000 fish. Adult returns from these releases, measured at the hatchery weir, ranged from about 4% to 13% of the upper Salmon River adult return goal.

To complete a performance appraisal for hatchery operation, two other measures are examined. The first of these is smolt-to-adult survival rate (SAR). The original facility development production model SAR was 0.87%. It is apparent in Figure 12 that this SAR has not been achieved (except for brood years 1980 and 1981) for releases into the upper Salmon River. The SAR necessary for replacement of hatchery brood stock is approximately 0.06%, and is a function of the high egg to smolt survival achieved in a hatchery. For comparison,

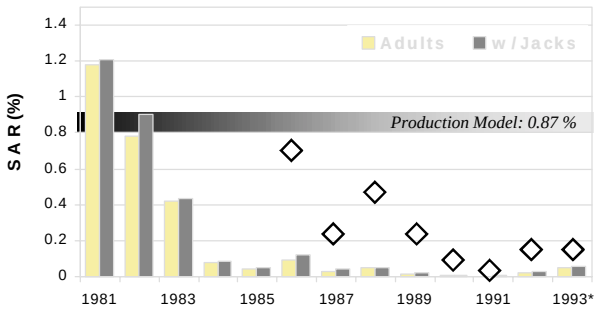

Figure 12.

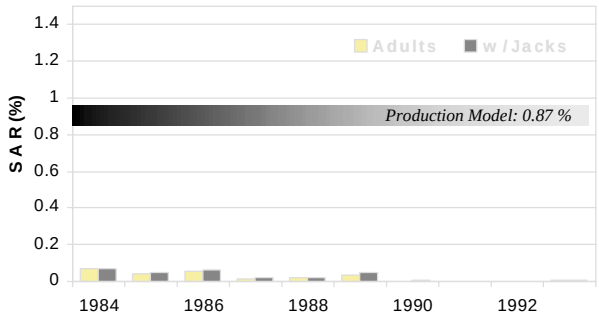

Figure 13.

the SAR necessary for replacement of wild spawners is about 0.6% (at 7% egg to smolt survival). The diamonds in the figure represent SARs for aggregate groups of wild Snake River chinook salmon (Russ Kiefer, IDFG, unpublished data). The SARs for wild fish also have been low and appear to trend in the same direction as SARs for the hatchery released fish. Smolt to adult return rates for releases made into the East Fork Salmon River are displayed in Figure 13. With the exception of brood year 1984, these SARs have consistently been less than the 0.06% necessary to achieve hatchery brood stock replacement.

The last measure in the performance appraisal of hatchery operations is progeny:parent ratios, an expression of the number of females returning for each female spawned to produce juveniles for release. Based on parameters used in the original production model, we estimate a progeny:parent ratio of about 14:1 to 16:1 was anticipated. The progeny:parent ratios incorporate the complete life cycle of events for the fish, which includes both in-hatchery and post-release survival. These progeny:parent ratios directly reflect the SARs shown in the previous figures. Progeny:parent ratios for upper Salmon River stock returning to Sawtooth Fish Hatchery are displayed in Figure 14 (note the divided y-axis). The ratios equaled or exceeded the replacement level for only those cohorts (brood years 1983, 1984, and 1986) when SARs also were above the replacement level. The moderately improved progeny:parent ratios for brood year 1993 are thought to largely be the result of better smolt

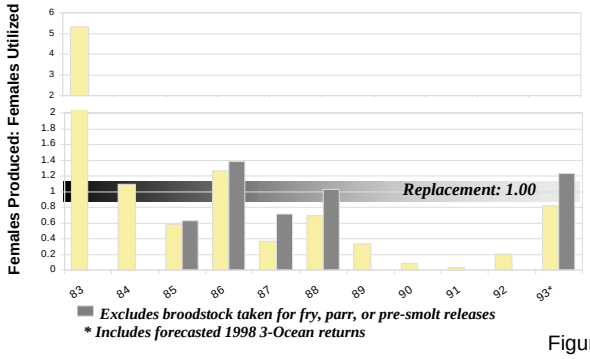

Figure 14.

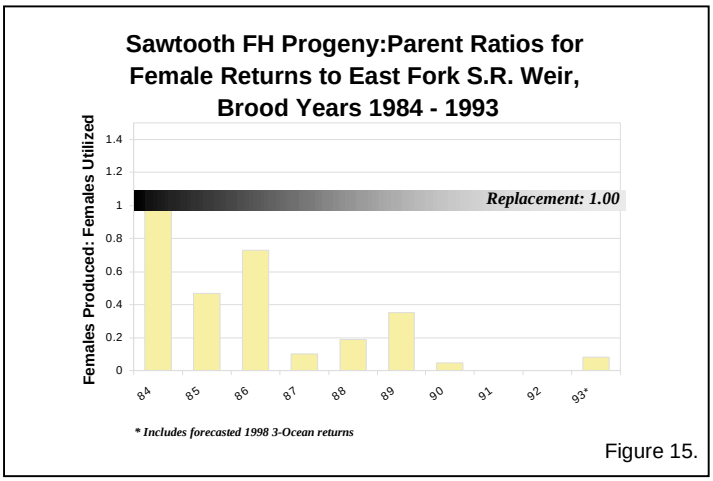

Figure 15.

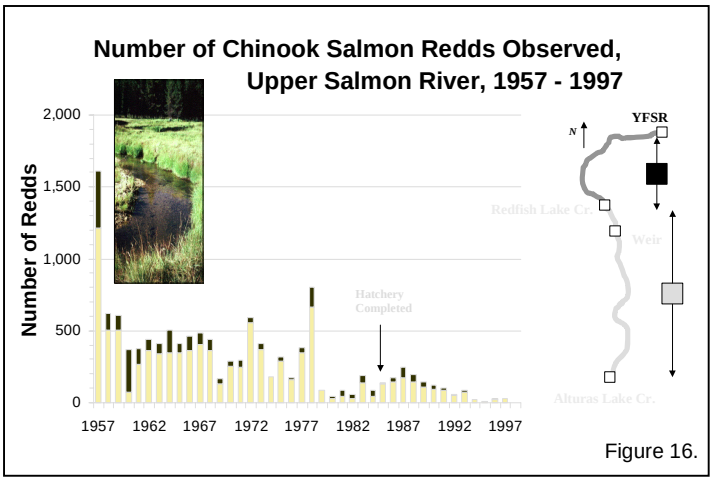

Figure 16.

out migration conditions in 1995 than in previous years.

Progeny:parent ratios for East Fork Salmon River stock (Fig. 15) have been below replacement for all years of facility operation except brood year 1984 (note: brood year 1984 progeny had been incubated and reared at McCall Fish Hatchery prior to the completion of the Sawtooth facility).

The last two data slides (Figs. 16 and 17) examine the influence of hatchery weir operations in the upper Salmon River on spawner redd distribution and benefits to natural production. The number of redds observed each year is shown for two stream reaches (Fig. 16); from the mouth of the Yankee Fork Salmon River upstream to the mouth of Redfish Lake Creek (or the hatchery weir beginning in 1985), and from the mouth of Redfish Lake Creek (or the hatchery weir) upstream to the mouth of Alturus Lake Creek (affected by hatchery trapping and release operations).

The combined number of redds observed in these two index areas was generally stable from 1958 through the late 1960s. In the 1970s considerable inter-annual variation was seen in the number of redds observed. Also, the number of redds observed in the down stream of the two index areas, and the proportion of the total observed redds in the down stream index area (Fig. 17) declined. This decline occurred prior to the construction of Sawtooth Fish Hatchery and installation of the weir. Although the total number of redds counted annually in the two index areas has decline since the 1960s, it does not appear that annual brood stock management at the hatchery weir has affected spawner distribution, or caused the decline in the number of spawners passed above the weir. Resolution of the data in Figures 16 and 17 is not fine enough to show impact of hatchery fallout below the weir. Fish returning from hatchery releases that do not recruit back to the weir are more likely to spawn within one mile of the weir.

A performance report card for the upper Salmon River spring chinook salmon compensation program was prepared. Performance in five areas is reported (Fig. 18). In-hatchery egg to smolt survival for both upper Salmon River stock and East Fork Salmon River stock has been consistently high. Smolt release targets have not been met, except for a few releases in the 1980s when sufficient adults were available to satisfy brood stock needs

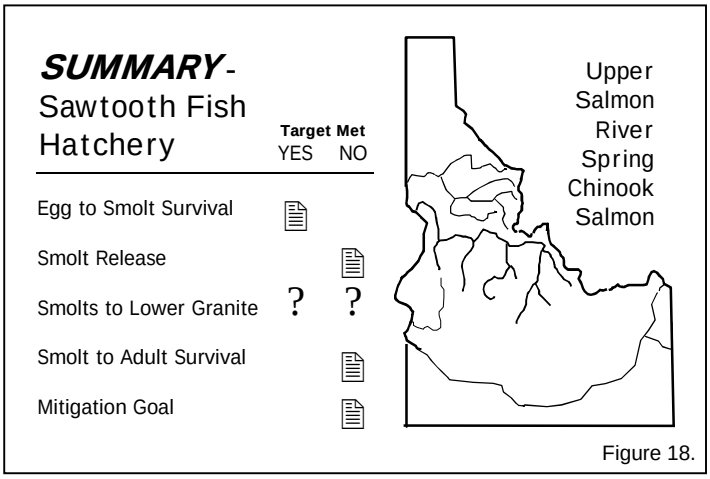

Figure 18.

Smolt survival from release to Lower Granite Dam is difficult to evaluate, since there are no targets or historical reference points. In, relation to wild fish (and based on detections of PIT-tagged fish), fish released from the hatchery are probably doing as well as can be expected. We will continue to monitor this performance measure.

Smolt-to-adult returns rates have consistently failed to achieve the production model target of 0.87%, and have been below the level needed for replacement in most years. There are no indications that this performance is due to hatchery operations or poor quality of the fish released. Similarly poor SARs have been documented for wild fish. Factors affecting SARs for these fish most likely operate outside of the upper Salmon River basin and hatchery environment. Poor survival through the lower Snake and Columbia rivers hydrosystem is considered to be the primary factor affecting fish survival.

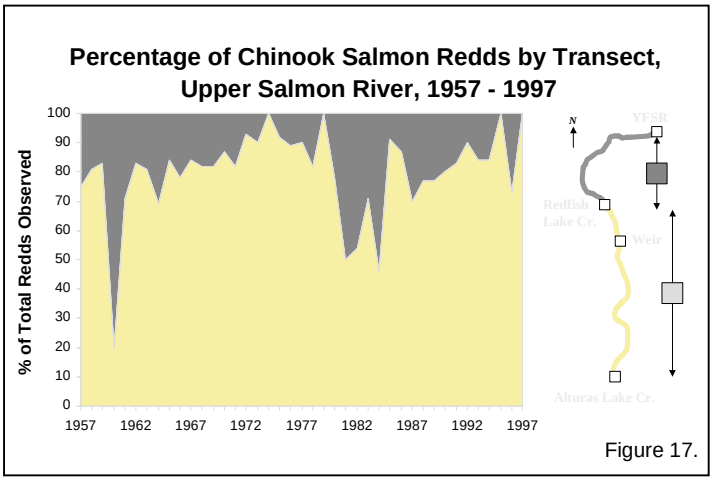

Figure 17.

The adult return compensation goal of 19,445 fish has never been met, and is most directly the result of the poor SARs exhibited. IDFG will continue efforts to improve in-hatchery performance. However, only small improvements can be expected, since in-hatchery survival and smolt quality is typically very good. These small improvements will not offset or overcome the extremely low SARs.

Three possible avenues are seen for the future of this spring chinook salmon compensation program (Fig. 19). The first avenue - status quo ecosystem - assumes no changes to be made in hatchery operations or ecosystem management (e.g. hydrosystem operations). Under this scenario we can only expect that a remnant run would persist, or the wild and hatchery stocks may go extinct.

If changes necessary to improve smolt-to-adult survivals are not made and the desire is to achieve the compensation goal of 19,445 adults, seven (at 0.1% SAR) to 40 (at 0.02% SAR) additional 'Sawtooth hatcheries' could be constructed to provide for the release of another 19 to 97 million smolts. A major problem with this avenue is that more hatcheries will not stop wild stock extinction or ease restrictions or management under the Endangered Species Act. Also, insufficient numbers of adults return at the present time to provide eggs for these "new" hatcheries.

The third avenue is to implement changes that would improve smolt to adult survival to a level of 2% to 6%. Any survival increases will be realized by both wild and hatchery populations, benefiting both. The Idaho Fish and Game Commission believes that a normative river is the best biological route to meeting this survival level. The Commission and the Idaho Department of Fish and Game do not desire to manage remnant populations that provide no fishery benefits.

Figure 20.

It is important to review these future management options to establish the current management framework (Fig. 20). The Idaho Department of Fish and Game's management focus is conservation and rebuilding of wild spring chinook salmon in the upper Salmon River basin. We are currently investigating, through a Bonneville Power Administration funded study, supplementation as a tool to rebuild the natural spawning population. While not meeting its compensation plan goal, the LSRCP-funded hatchery program plays an important role in management of upper Salmon River salmon. Adaptive hatchery management actions are implemented to respond to management needs of naturally produced fish in the upper basin. The supplementation research

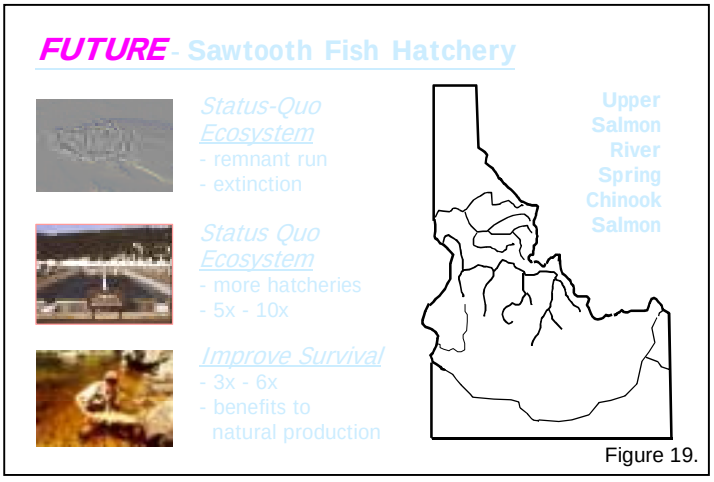

Figure 19.

program utilizes some natural-origin adults as brood stock to produce juveniles for release, and the juveniles are reared in the hatchery. In addition to the supplementation fish, the general production (compensation program) brood stock is maintained to achieve the goal of the LSRCP program and provide fishing opportunity in the future. The general production fish are managed to provide a safety net or reserve should natural-origin returns become so critically depressed that recovery without intervention actions is unlikely. Operations planning and management of the hatchery program acknowledges the Idaho Department of Fish and Game's highest priority -- wild/natural stock conservation and rebuilding -- while continuing to support the facilities objective of compensating for reduced fish survival due to hydroelectric development and providing fishing opportunity.